CHROMOSOME STUDIES IN KUHNIINAE (EUPATORIEAE). I. BRICKELLIA[1]

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Introduction

Among the many outstanding contributions to the taxonomy of the *Compositae* by Robinson, the monograph (1917) on *Brickellia* clearly presents that author's interpretation of the genus. The excellent drawings of portions of inflorescences with leaves, especially indicate the attention given to specific and varietal characters of the head, achene, florets, and phyllaries. He included ninety-one species, eighty of them considered unquestionably distinct. In the introduction he expressed his difficulty in making any division of the genus into true subgenera. To him it was best divided into nine sections of closely related species. Admittedly, these were separated sometimes by rather artificial boundaries. The sections are of very varied size, seven consisting of one, two or three species while one, *Bulbostylis*, contains seventy-seven species in nine subsections. It should be pointed out that as the genus occurs mostly in the less accessible mountain ravines and deserts of Mexico, there were at that time not a great many herbarium specimens, some species being represented by one or at most a few collections. This fact contributed to the placement of some in the doubtful category.

This painstaking treatment of a genus presented a challenge for a cytological inquiry of the chromosome numbers of the species covered. Besides, Robinson (1913) had also presented a key to the subdivision *Eupatorieae* of the *Compositae* in which *Brickellia* is found in the small subtribe *Kuhniineae*. This consists of nine mostly small genera, of which *Brickellia* has the largest number of species and *Liatris* is second with approximately thirty-two species (Gaiser, 1946). Since I have previously reported on chromosome numbers in *Liatris* (Gaiser, 1949, 1950 a and b), an American genus chiefly of United States and Canada, it was of considerable interest to examine a larger closely related genus having a more southerly geographic dis-

[1] The author is grateful to Dr. P. C. Mangelsdorf and Dr. R. C. Rollins for valued criticism of this manuscript.

tribution. *Brickellia* occurs from the northern boundary of United States in Washington, southward through the western states (with one species in the east) through Mexico and Central America and perhaps sparingly in eastern Brazil, but it is especially abundant in Mexico.

The general features of the genus *Brickellia* are well presented by Robinson and through the sections one follows from small heads of eight, to the largest, of over one-hundred florets. The species are chiefly calciphiles, xerophytic in varying degree and occurring mostly in mountain ravines with some limited to deserts. It may be emphasized here that in comparison with a perennial herbaceous genus such as *Liatris*, *Brickellia* consists about equally of shrubs and perennial herbs, with intermediate types, and includes at least one annual. The general shrub-like nature of many species of western United States stimulated an inquiry regarding the nature of those of the more southern countries. Are species of Mexico and Central America more woody? If so how do the chromosome numbers[2] of woody *Compositae* compare with those of closely related herbaceous ones? If there are varying chromosome numbers in the genus, are the more basic numbers found in species of the tropics?

The cytological studies have put particular emphasis on comparisons of the karyotypes of the various species, believing that if karyology is neglected, one of the soundest indicators of the major trends of evolution may be missed. In conjunction with the chromosomal variations an attempt was made to see if any correlations could be found which might be of further aid in taxonomic classification. This included microscopic examination of the various parts of the plant: the trichomes, secretory glands, the so-called punctate condition of the leaves; and the barbules of the pappus.

Methods

In Guatemala, during the last two weeks of September, 1950, it was found that *Brickellia adenocarpa* Robinson, the species apparently common in the Departments of Sacatapequez and

[2] The author most gratefully acknowledges the primary aid of a grant from the American Philosophical Society for this project which made possible a trip to Guatemala and Mexico for the collection of cytological materials in the field. I wish to acknowledge also a subsequent grant from the American Academy of Arts and Sciences received for assistance in getting timely attention for the material brought back, such as germinating seeds at once before they became inviable, etc.

Guatemala, had not begun to flower in some stations and in others it was just beginning to do so. With many more species occurring in Mexico than Guatemala, I proceeded there and in the six-week period spent in the plateau states of Mexico, Oaxaca, Michoacán (around Morélia), Jalisco (Guadalajara and Rio Blanco), Guerrero (Taxco), Morelos (Cuernavaca and Yautepec), Puebla (Izucar de Matamoros) and on a trip to Vera Cruz via Orizaba and returning via Jalapa, more than a dozen species and several varieties were obtained in satisfactory stages for meiotic study. Of at least as many more it was possible to collect seeds. A few of the species were only encountered once. However, in most of them it was possible to make comparisons through collections from several stations. Seeds of four other species were obtained a year later from people with whom contacts had been made.

Collection of cytological material of this genus in Mexico was fortunately greatly helped by taking along a plastic bag referred to by Stevens (1949). Since the cytologist must collect and press specimens as adequate reference- and identification-material, as well as fix the flowering material wherever it is found it is usually necessary to take along into the field a kit of fixing materials. From the earliest trips made, it was learned that branches of these shrubby plants, which had been carried in a plastic, zipper-closed, pillow-case throughout the morning and into the afternoon collecting period, had not wilted upon return to quarters. Transpiration vapor collected on the inside of the slightly inflated case and the leaves and heads seemed as though freshly cut. Upon removal of the involucre, the florets of young heads which were considered to be of the proper age for meiotic stages, seemed equally fresh and suitable for fixation. Thus this procedure was almost entirely depended upon for the reason that it gave greater convenience in the adequate selection and handling of the materials, and also because it left more time for actual collection when in the field. Perhaps delicate annual plants could not have been handled thus but this method might ease the cytologists' problems with at least the more xerophytic types.

The fixative used was that of Karpechenko as used by Langlet (1932) and as previously employed for studies of *Liatris*. It had

been found to be a good fixative as well as an expedient one since materials had been left in it unharmed during the busy summer season and then were examined later. The flowering material of the native shrubs collected in Mexico in the Autumn were examined in the Winter and Spring months in the laboratory. There was no evidence of shrinkage or mal-fixation, at least no greater incidence than exists in the fixations of a normal project with the plants to be studied in the greenhouse or experimental plot. Evidence of the clarity of figures obtained can be seen in photomicrographs of figures 50 to 60.

Of the species which were already fruiting, the seed collected was germinated as soon as possible upon return so as not to miss their periods of viability. The root-tips obtained were examined variously. Some comparisons were made following the ordinary smear technique with aceto-carmine stain and also Feulgen's (Meyer, 1943). Meyer's (1945) paradichlorobenzene technique was also tested and proved to give as claimed, shortening of the mitotic chromosomes (see fig. 35). Results from aceto-carmine smears were not often good, probably due to the secretory inclusions, which often caused a darkening of the cytoplasm unsatisfactory for photomicrography. Whenever seedlings were obtained and grown in the greenhouse, root-tips from these were fixed, stained *in toto*, in Feulgen's and afterwards embedded through a rapid alcohol-chloroform-paraffin technique. Others were fixed in Karpechenko's and Belling's followed by Newton Gentian Violet stain. As the latter method had been employed for the study of the earliest received species in 1948, it formed a basis for general comparison of chromosome morphology of species within this genus as well as with those of the other related genera of the *Kuhniineae*. Of any recent herbarium specimens[3] received, seeds were always tested and of course, packets of seeds gave abundant material. Seeds of species from western United States were usually found inviable if more than two years old. Occasional exceptions were found as in a few each of *Brickellia Coulteri* Gray, *B. megaphylla* Jones and *B. macromera* Robinson from Baja California. However, the seeds collected

[3] The author wishes to express gratitude to all who have contributed any specimens, all of which grow in less readily accessible places. Especially am I indebted to Mr. A. G. Johnson for collecting in the Durango-Chihuahua region of Mexico and the Chiricahua Mts. of southwestern Arizona while on a return trip from Mexico City.

in southern Mexico and also in samples received from Costa Rica (*B. argyrolepis* Robinson) and Honduras (*B. adenocarpa*), proved noticeably less viable within five months. One remarkable exception was found in the only annual species studied, *B. diffusa* (Vahl) Gray. The minute seeds of the one accession which germinated had been collected more than five years previously.

For the examination of trichomes and glands, leaves from herbarium specimens were cleared in approximately twenty percent sodium hydroxide for varying lengths of time according to their thickness and then dehydrated and mounted in diaphane. The more delicate leaves of seedling plants were preferably cleared in lactic acid and similarly mounted. Preparations of pappus required heating in water to drive out the air bubbles before mounting in lactic acid.

Material

In table I are given the names of species which it has been possible to examine so far, as well as the name of the collector, the number, time and place of collection of each accession.[4] They have been arranged according to the sections given by Robinson, with inclusion of the number (in brackets) of species belonging to each section or subsection and their general habit of growth.

One species, *B. diffusa*, of the only possible two annuals that make up Section I, had been collected from two stations in Mexico but none of these seeds proved to be mature. It was most gratifying therefore that in a chance trial of seeds of the most recent collection available in the Gray Herbarium, one of 1946 from Panama, a few proved to be viable. The lack of any representatives of the small sections II to VI is in part explained by their greater inaccessibility. Sections III and IV are each represented by a single Brazilian species, of which the former, for lack of sufficient material, Robinson placed in this genus

[4] Specimens collected by the author will be deposited in the Gray Herbarium and duplicates in the National Museum, Washington, the Instituto di Biologia, Mexico, and the University of Michigan, Ann Arbor. References to other collectors' numbers will permit the reader to examine a number of other specimens in various herbaria.

TABLE I
Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection No.	Subsection Name	Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No. n	Chromo. No. 2n
LEPTANTHODIUM I (2 sp.)			Annuals	*B. diffusa*[1]	III	Panama	San José Is.	I. Johnston 1281 1/29/46		18
BULBOSTYLIS VII	1	CLAVIGERA (2 sp.)	perennial herbs, a little woody at the base	*B. scoparia*	I	Oax., Mex.	n. of Oaxaca, along trail to San Juan del Estado	L. O. Gaiser[2] 39, 10/15/50	9	
					II	Mich., Mex.	n. side of Mt. Punguato just w. of Morelia	L. O. Gaiser 54, 10/25/50	9	
	3	MICROPHYLLAE (4 sp.)	shrubby xerophyte	*B. Nevinii*	I	Cal.	San Rafael Hills, w. of Pasadena, Los Angeles Co.	L. C. Wheeler 6372, 10/11/52		18
				B. microphylla	Ia	Wash.	2 mi. w. Asotin, Asotin Co.	M. Ownbey, 3168a 10/49	9	18
					II	Cal.	Rancho Santa Ana B. G.	P. Munz, 11/8/48		18
				B. scabra	I	Col.	Mesa Verde Nat. Park, Montezuma Co.	W. A. Weber 5243 9/14/49		18
	4	PARVULAE (4 sp.)	mostly perennial herbs	*B. dentata*	I	Tex.	Neuces R. at Barksdale, Real Co.	H. R. Reed 683 11/2/49		18
				B. brachyphylla	II	Col.	Mesa Verde Nat. Park, Montezuma Co.	W. A. Weber 5216 9/10/49		18
					III	Okla.	3 mi. n. of Kenton, Cimarron Co.	U. T. Waterfall 9717 10/7/50	9	18

TABLE I—Continued

Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection No.	Subsection Name	Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No. n	Chromo. No. 2n
	5	RETICULATAE (7 sp.)	Perennial herbs from a woody caudex	*B. venosa*	IV	Ariz.	Santa Catalina Mts., Pima Co.	K. F. Parker 7405 10/19 50	9	18
				B. oliganthes	I	Mich., Mex.	n. side of Mt. Punguato just w. of Morélia	L. O. Gaiser 55 10/25/50	9	18
				B. reticulata	I	Mor., Mex.	23 kms. from Cuernavaca on the Yautepec road	L. O. Gaiser 82 11/3/50	9 irr.	18*
				B. verbenacea	I	Jal., Mex.	On the Ameca Hwy. 38 kms. from Guadalajara	L. O. Gaiser 59 10/26/50	9	
					Ia	Jal., Mex.	On the Ameca Hwy. 38 kms. from Guadalajara	M. S. de Castillo 12/50		18
	6	AMPLEXICAULES (4 sp.)	Perennial herbs or a little woody	*B. cuspidata*	I	Jal. Mex.	El Colli, 30 kms. S. W. of Guadalajara	M. S. de Castillo 2/12/52		18
				B. betonicaefolia	I	Ariz.	Santa Catalina Mts., Pima Co.	F. W. Gould 5237 10/4/48	9	18
				B. amplexicaulis	I	Ariz.	Mt. Lemmon, Pima Co.	K. F. Parker 7403 10/11/50	9	18
	7	BRACHIATAE (6 + 2 sp.)	Perennial herbs or shrubs	*B. Coulteri*	IV	Baja Cal., Mex.	19.2 mi. s. w. of San José del Cabo	A. Carter, L. Kellogg & A. Alexander 2240 12/17/47		18

TABLE I—Continued

Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection No.	Subsection Name	Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No. n	Chromo. No. 2n
				B. megaphylla	I	Baja Cal., Mex.	Arroyo Hondo, n. side of Cerro la Giganta	A. Carter, L. Kellogg & A. Alexander 2056 11/27/47		18
	8	BACCHARIDEAE (7 sp.)	Xero-phytic shrubs	*B. laciniata*	I	Tex.	Sul Ross College Hill, Alpine	B. H. Warnock 12/4/48		18
					II	Dur., Mex.	Mexico-Chihuahua Hwy. 1160 Kms. from Mexico	A. G. Johnson 8, 10/20/50		18
				B. desertorum	I	Cal.	Citrus Expt. Sta., Riverside, Riverside Co.	L. C. Wheeler 6380, 10/30/52		18
				B. californica	I	Cal.	Altadena, Los Angeles Co.	L. C. Wheeler 12/6/47	9	18
					II	Cal.	San Gabriel Mts., San Bernardino Co.	L. C. Wheeler 10/9/47		18
					IV	Cal.	Rancho Santa Ana B. G., Anaheim	P. Munz 11/8/48		18
					V	Ariz.	Santa Rita Mts., Santa Cruz Co.	F. W. Gould 5234, 9/27/48		18
					VI	Ariz.	Mt. Lemmon, Pima Co.	F. W. Gould 5236, 10/4/48		18
					XI	Cal.	Carmel Valley, Monterey Co.	Mrs. R. Ferris 10/29/49		18
					XII	Col.	3 mi. n. Lyons, Boulder Co.	W. A. Weber 3/8/50		18

TABLE I—Continued

Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection No.	Subsection Name	Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No. n	Chromo. No. 2n
					XIII	Ariz.	28 mi. n. e. Tucson, Pima Co.	K. F. Parker 7128, 10/10/49		18
					XIV	Col.	Mesa Verde Nat. Park, Montezuma Co.	D. Watson 10/15/50		18
					XV	Utah	3 mi. n. e. Provo, Wasatch Co.	B. F. Harrison 11/16/50		18
					XVI	Ariz.	Santa Catalina Mts., Pima Co.	K. F. Parker 7404, 10/11/50		18
					XVII	Ariz.	Coronado Nat. Park, 9000 ft.	A. G. Johnson 19, 10/26/50		18
					XVIII	Ariz.	Chiracahua Mts., 7000 ft.	A. G. Johnson 20, 10/27/50		18
				B. veronicaefolia var. *veronicaefolia*	II	Pueb., Mex.	On Hwy to Puebla City, 42 kms. from Mexico	L. O. Gaiser 14, 10/13/50	9	
				B. veronicaefolia var. *senilis*	I	Pueb., Mex.	On road from Mexico to Orizaba, near Azumbillo	L. O. Gaiser 21, 10/13/50	9	
				B. veronicaefolia var. *umbratilis*	II	Dur., Mex.	Durango-Chihuahua Hwy. 870 kms. from Mexico	A. G. Johnson 7, 10/20/50		18
				B. Palmeri var. *amphothrix*	I	Dur., Mex.	Mexico-Durango Hwy. ca. 870 kms. from Mexico	A. G. Johnson 3, 10/18/50		18

TABLE I—Continued

Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection No.	Subsection Name	Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No. n	Chromo. No. 2n
					II	Dur., Mex.	Mexico-Durango Hwy. ca. 870 Kms. from Mexico	A. G. Johnson 4, 10/18/50		18
	9	COLEOSANTHUS (22 sp.)	Perennial herbs and shrubs	*B. Rusbyi*	II	Ariz.	Santa Catalina Mts., Pima Co.	F. W. Gould 5237, 10/4/48	9	18
					III	Ariz.	Coronado Nat. Park	A. G. Johnson 17, 10/26/50		18
					IV	Ariz.	Between Pinery Canyon & Barfoot Pk. Coronado Nat. Park	A. G. Johnson 21, 10/27/50		18
				B. glomerata	I	Mor., Mex.	Near bridge, Calle Tunnell, Cuernavaca	L. O. Gaiser 11, 10/9/50	9	
					IV	Mor., Mex.	Ca. 20 kms. from Cuernavaca on Yautepec road	L. O. Gaiser 83, 11/3/50		18
					V	Guer., Mex.	4 kms. from Taxco on Hwy. to Mex.	L. O. Gaiser 87, 11/4/50	9 irr.	
				B. paniculata	I	Oax., Mex.	Along the road from San Felipe village to mt.	L. O. Gaiser 26, 10/18/50		18
					III	Oax., Mex.	510 kms. from Mexico City to Oaxaca, just past Huitzo	L. O. Gaiser 35, 10/19/50		18
					X	Oax., Mex.	At the foot of Monte Alban, near Oaxaca City	L. O. Gaiser 49, 10/20/50		18

TABLE I—Continued

Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection No.	Subsection Name	Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No. n	Chromo. No. 2n
					XI	Jal., Mex.	On the Ameca Hwy. 38 kms. from Guadalajara	L. O. Gaiser 57, 10/26/50		18
					XII	Chiap., Mex.	Eastern region of Tuxtla Gutierrez	F. Miranda 4/28/51		18
				B. secundiflora var. *secundiflora*	II	Mex., D. F.	Molino de Flores, 3 mi. e. of Texcoco	E. Matuda 25720, 11/18/51		18
				B. secundiflora var. *nepetaefolia*	I	Mich., Mex.	Along walls at Santa Maria, 5 kms. from Morélia	L. O. Gaiser 51, 10/23/50	9	
				B. tomentella	IV	Pueb., Mex.	Near Cumbres de Acultzingo, ca. 8000′, Puebla to Orizaba	L. O. Gaiser 22, 10/13/50		18
					V	Oax., Mex.	Between San Felipe village and Oaxaca, along fences	L. O. Gaiser 33, 10/18/50	9	
					VII	Mex., D. F.	Venacho Mt., Amecameca	E. Matuda 25884, 12/9/51		18
				B. nutanticeps	I	Mexico, D. F.	Woods below el Desierto de los Leones	L. O. Gaiser 6, 10/8/50		18*
				B. pendula	III	Pueb., Mex.	Ca. 205 kms. from Mexico City on Jalapa to Puebla road	L. O. Gaiser 25, 10/14/50	9 irr.	

TABLE I—Continued

Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection No.	Subsection Name	Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No. n	Chromo. No. 2n
				B. argyrolepis	I	Alajuela, Costa Rica	Rio de los Ahogados Carrizal	J. Leon 5/2/50	9	18
				B. adenocarpa var. *glandulipes*	I	Sacat., Guatemala	Northern outskirts of Antigua, above "Candelaria" Coffee Plantation	L. O. Gaiser 1, 9/25/50	9	18
					III	Guat., Guatemala	Escuela d'Agricultura, near Villa Nueva	L. O. Gaiser 3, 9/26/50		18
					V	Sacat., Guatemala	On left slope of Volcan Agua, Antigua, on Finca Carmona	L. O. Gaiser 5, 9/29/50		18
					VI	Honduras	Quebrada Dantas, El Paraiso	L. Williams 17204, 3/12/50	9	18
				B. pacayensis	I	Mor. Mex.	Oaxtepec, n. w. of Cuautla	E. Matuda 26035, 3/16/52		18
				B. floribunda	I	Ariz.	Santa Catalina Mts., Pima Co.	K. F. Parker 7408, 11/4/50		18
EUBRICKELLIA VIII (18 sp.)			Perennial herbs or shrubs	*B. oblongifolia* var. *linifolia*	II	Ariz.	Betatakin, Navajo Co.	J. T. Howell 24544, 6/22/48		18
				B. Greenei	I	Cal.	South Fork Indian Creek, Siskyou Mts., Siskyou Co.	L. C. Wheeler 6248, 9/18/52		18

TABLE I—Continued

Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection No.	Subsection Name	Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No. n	Chromo. No. 2n
				B. Wislizeni	I	Dur., Mex.	Durango to Chihuahua Hwy. 1455 kms. from Mexico	A. G. Johnson 16, 10/20/50	9	18
				B. macromera	I	Baja Cal., Mex.	Arroyo Hondo, n. side of Curode la Giganta	A. Carter, M. Alexander & L. Kellogg 2058, 11/27/47		18
				B. peninsularis	I	Baja Cal., Mex.	W. side of Cabin la Laguna, Sierra la Laguna	A. Carter, M. Alexander & L. Kellogg 2371, 12/5/47	9	18
				B. grandiflora	II	Wash.	Ca. 1.6 mi. s. of Seven Mile Bridge Spokane R., Spokane Co.	Mrs. Gaines 150, 9/25/48	9	18
					III	Ariz.	Santa Catalina Mts., Pima Co.	K. F. Parker 7343, 9/20/50	9	18
				B. incana	I	Cal.	15 mi. e. of Balser, San Bernardino Co.	M. Ownbey 9046, 7/9/46		18
					II	Cal.	Rancho Santa Ana B. G., Anaheim	P. Munz 11/8/48		18
				B. lanata	I	Jal., Mex.	Along rwy. track near Hwy. 48 kms. from Guadalajara on Ameca Road	L. O. Gaiser 60, 10/26/50		18

TABLE I—Continued

Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection No.	Subsection Name	Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No. n	Chromo. No. 2n
					II	Jal., Mex.	On slopes of Barranca, Guadalajara	L. O. Gaiser 64, 10/27/50		18
					IV	Jal., Mex.	63 kms. n. w. of Guadalajara in Barranca at Tequila	M. S. del Castillo 12/11/50		18
MACRO-BRICK-ELLIA IX (1 + 1 sp.)			Perennial herbs with tubers	*B. monocephala*	I	Mex., D. F.	El Salto Hills, n. w. of Hue-huetoca	D. B. Gold & C. Eheberle 8/12/51		18

* This from a somatic division in the young stylar tissue.

[1] The authorities for species have been omitted from the table. All species are as given by Robinson (1917) except *B. megaphylla* Jones and *B. nutanticeps* Blake (1943) which replaces the invalid *B. nutans* (HBK) Robinson.

[2] In the case of the author's own collections, the *n* number was obtained from the meiotic material fixed in the field and in other accessions from plants grown in the greenhouse, from seeds obtained from collectors.

somewhat doubtfully. Sections II[5] and VI each consist of three Mexican species and section V of the same number from western United States. There is good representation of eight of the nine subsections of Section VII, lacking only the monotypic species of subsection 2. Section VIII is equally well represented by about half of its species. Section IX is fortunately represented by *B. monocephala* Robinson[6] which is singular in having the largest heads and they are borne singly on peduncles. Though it was the only species belonging to the section in Robinson's treatment, more recently one other has been added, *B. Robinsoniana* Blake (1941). From the number of species given in brackets below each subdivision in table I, it is evident that in general each is represented by about half of its total number.

[5] More time and effort was spent in hunting for the herbaceous *B. pulcherrima* Robinson on the limestone mountains both at Jautepec, in Morelos, and about Izucar de Matamoros, in Puebla, than in the search for any other species. Dr. F. Miranda, who in 1941 had made a collection of it in the latter locality, felt that the unusually dry period in 1950 would have been very unfavorable for this more delicate and attractive species, the only one reported confidently as worthy of horticultural use. The former type locality presented the additional disadvantages of a closely grazed mountain, now riddled with limestone quarries.

[6] This species named by Robinson from a specimen collected by C. G. Pringle in 1901 in the hills of El Salto, Hidalgo, was also collected by Dr. Manuel Martinez Solorzano, who accompanied Pringle on trips when he was in the vicinity of Morelia (see Davis (1936) p. 242). When in that city, I saw the specimens collected by this guide of Pringle's, in the Michoacán Museum, and fortunately made the acquaintance of his son, a medical doctor there, Dr. Eugenio Martinez Baez, who is the son mentioned in Pringle's diary. Therefore he was able to take me to the exact locations he had visited with his father and Pringle. What was then a natural park, Juarez Park, where *B. monocephala* had been collected, was much like any other city park and the native vegetation had been pushed back. Upon visiting other places in Mexico on a list prepared from the given locations of specimens in the Gray Herbarium, the same condition was found frequently, but more harrowing still were the generally overgrazed hillsides and denuded forest slopes. Nevertheless I would like at this time to pay tribute to the monumental work represented by the collections of Pringle, not only for the actual specimens but also for the locations which along with his field notes made possible the excellent compilation by his daughter, Mrs. H. B. Davis. This should be a "must" reference for any field worker in regions of Mexico visited by this hardy earlier botanist. With the rapidly changing conditions for native plants, it is of great help to know just where certain species did grow fifty years ago. After referring to the account of Pringle's journeys to the hills of El Salto in Hidalgo for *B. monocephala*, Mr. D. B. Gold of Mexico City, made a trip there in August, 1951, and thus one year later, made good for this author's failure to find that rare species about Morélia.

(*To be continued*)